

Open product lifecycle data sharing using XML

white paper:
PLM XML



- The manufacturing industry is demanding unprecedented levels of interoperability between PLM software applications to help accelerate critical business process threads and achieve significant cost savings and time to market advantage. PLM XML from EDS boosts interoperability by defining a set of W3C standard XML schemas and associated services to facilitate open, high-content, product lifecycle data sharing.



Table of contents

Executive summary	1
Vision and objectives	1
PLM XML explained	2
PLM XML schemas	3
PLM XML characteristics	3
PLM XML in action - pipeline, toolkits and services	4
PLM XML pipeline	4
PLM XML toolkits	5
Data adapters	5
Representation handlers	5
PLM XML in the enterprise	6
PLM XML for interoperability	6
PLM XML for collaboration	7
PLM XML for integration	8
PLM XML and standards	9
Summary	9

Table of figures

Figure 1 : PLM XML vision - high-content data flow between application domains	1
Figure 2 : A PLM XML document fragment	2
Figure 3 : A PLM XML schema fragment and tree hierarchy	2
Figure 4 : PLM XML services populate and exploit the PLM XML pipeline	4
Figure 5 : PLM XML jumpstart application showing a crankshaft example	5
Figure 6 : PLM XML facilitating interoperability between applications	6
Figure 7 : Flexible PLM XML payload provides appropriate levels of detail	7
Figure 8 : PLM XML in support of enterprise application integration	8

Executive summary

Interoperability issues within and between organizations using software applications to conceive, develop, engineer, manufacture, and maintain products cost industry billions of dollars annually. Initiatives to improve interoperability in heterogeneous application environments are therefore of vital importance, and consumers are demanding unprecedented levels of interoperability between PLM software applications to help accelerate critical business process threads, increase ROI, and augment time to market advantage.

Vision and objectives

PLM XML is a set of W3C standard XML schemas and associated services to facilitate high-content product lifecycle data sharing using XML. EDS already provides and supports the highly successful representation pipelines which link authors and consumers of the open Parasolid XT solid model format and the visualization JT format. To enable broader, flexible interoperability across key PLM applications, PLM XML is designed to bring together product structure, product information, part representations and metadata in a lightweight, Web-friendly standard format, suitable for transferring high-content product data across the Internet.

The functional objectives of PLM XML are to:

- Orchestrate product structure, product information and geometric representation data in an open, lightweight and extensible form
- Share relevant information through the product lifecycle by offering a standardized protocol for data interoperability
- Integrate collaborative product lifecycle processes by providing a coherent flow of data within a heterogeneous application environment

The PLM XML vision aims to meet the following key objectives:

- Open specification
 - Open content, standard W3C XML schema basis
 - Published on www.plmxml-eds.com
 - Complementary to existing and emerging formats and standards
- Supported by PLM XML software services to facilitate easy implementation
 - PLM XML SDK developers toolkit to implement PLM XML read/write
 - Adapters and representation handlers to retrieve/consume referenced data
- Adoption by key applications throughout the product lifecycle
 - Enable a rich pipeline of product data
 - Address the needs of real-world collaborative scenarios
 - Operate effectively in a heterogeneous application environment

The following sections explain in more detail the composition and usage of PLM XML.

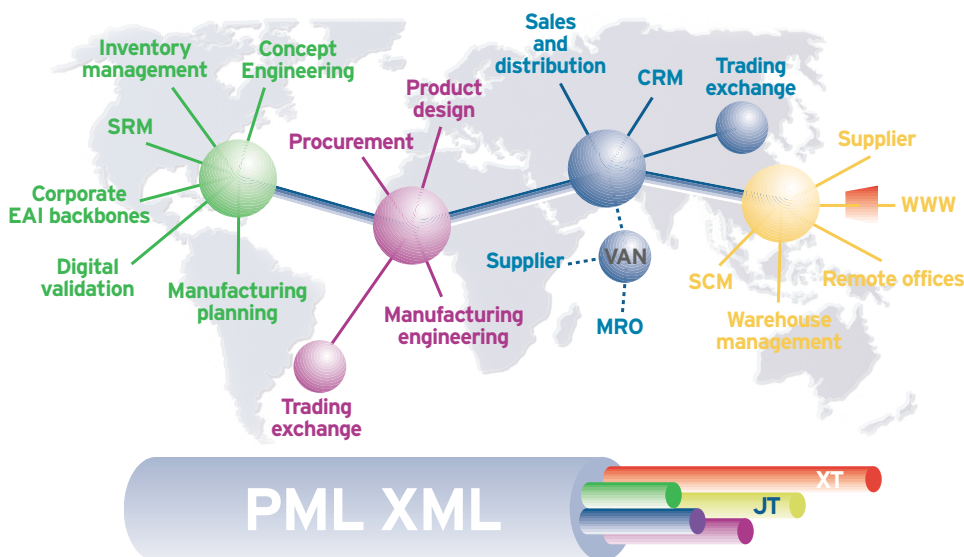


Figure 1. PLM XML vision - high-content data flow between application domains

PLM XML explained

PLM XML is defined by a set of W3C standard XML schemas, and is a transport protocol for exchanging product lifecycle data. PLM XML is designed to support interoperability in a collaborative environment by representing a payload of high-level product data in XML form, and providing mechanisms to enable drill-down to the detailed model data. An example PLM XML document fragment is shown in Figure 2.

```
<?xml version="1.0" standalone="no"?>
<PLMXML xmlns="http://www.plmxml.org/Schemas/PLMXMLSchema" schema
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
time="14:49:12" language="en" date="2001-12-19">
  <ProductDef id="id1" name="assembly" revision="1">
    <InstanceGraph id="id2" rootInstanceRef="id3">
      <Description>
        Product hierarchy for sample car, distributed over two fil
      </Description>
      <Instance id="id3" partRef="#id4"/>
      <Instance id="id6" partRef="#id7"/>
      <Instance id="id10" partRef="car_axle_assembly.plmxml#id11">
      <Instance id="id24" partRef="car_axle_assembly.plmxml#id11">
      <Part id="id4" type="assembly" instanceRefs="id6 id10 id24">
      </Part>
      <Part id="id7" type="solid" representationRefs="id9">
      </Part>
      <Transform id="id23">1 0 0 0 0 1 0 0 0 0 1 0 0 1 0 1</Trans
      <Transform id="id25">1 0 0 0 0 1 0 0 0 0 1 0 0 -1 0 1</Tran
    </InstanceGraph>
    <Representation id="id9" name="car_id7" format="XT" revision=
      <Description>
        Chassis of Car assembly
      </Description>
    </Representation>
    <ProductView id="id26" primaryOccurrenceRef="id27">
```

Figure 2. A PLM XML document fragment

By taking advantage of the web friendly nature of XML, and by concentrating the high-level data in a format that can equally be e-mailed or silently downloaded depending on security settings and requirements, PLM XML enables collaborating teams to work in ways that adapt to real-world situations, whether it means addressing firewall issues, accessing central web servers, or working across an intranet.

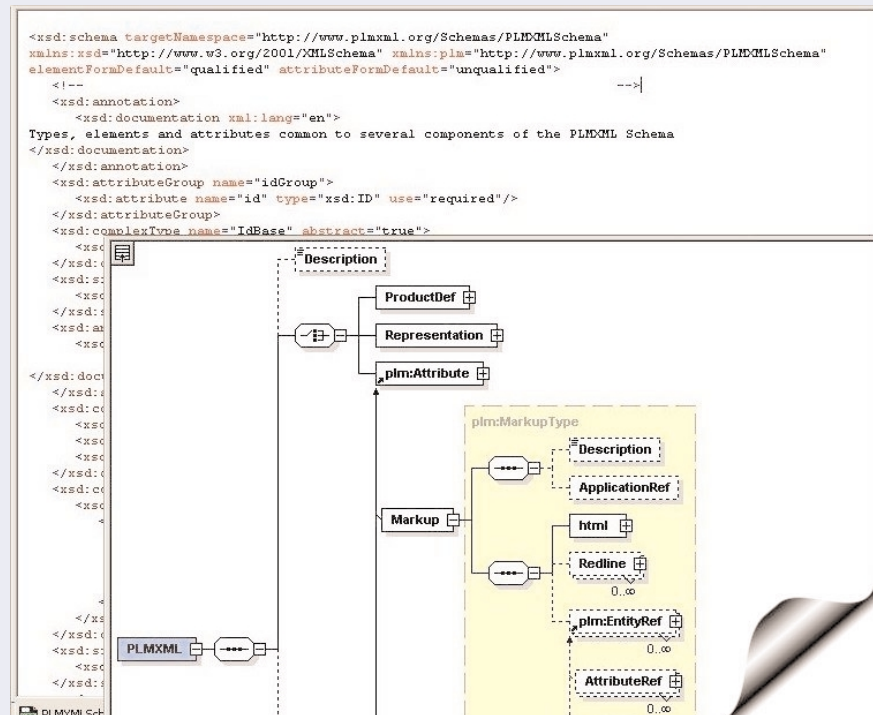


Figure 3. A PLM XML schema fragment and tree hierarchy

PLM XML schemas

PLM XML schemas define a hierarchy of product information and relationships (see example fragment in Figure 3), and are versioned and managed by EDS. In PLM XML version 1.0 the supported data includes the following:

Evaluated product structure

PLM XML schemas define a mechanism for exchanging evaluated product structure, suitable for product development, BOM, and assembly visualization. The product structure can be represented via an instance graph structure as well as multiple (occurrence-based) product views. The product views can reference the instance graph to enable display configurations based on an internal structure.

Part representation

PLM XML includes the concept of a part and its metadata, but does not include schema definitions for the explicit geometric component representations. Instead, parts within PLM XML can reference multiple external representations – the receiving application can decide which representation is suitable for loading.

Visualization properties

PLM XML provides visualization property exchange in the form of view controls (view directions, view ports, view characteristics) and display controls (lights, backgrounds, etc).

Reference geometry

PLM XML can exchange reference or wireframe geometry via its geometry schemas. The schemas are based on Parasolid geometry definitions and include NURBS and analytic forms.

Features (visualization)

PLM XML supports a feature representation, including feature hierarchy, suitable for visualization and feature browser applications.

Associativity

PLM XML defines elements to enable associativity back to the sending application. This associativity is an optional element that may be added to virtually any PLM XML element that describes the name of the sending application and a persistent label for the object itself (an optional version may also be specified). The label is specific to the sending application but may be used by the receiving application to label the equivalent object.

Component reference

PLM XML uses a standard URL/URI mechanism for specifying the location of data elements within a distributed data environment.

Entity reference

PLM XML has extended the URI mechanism via a 'PLM XML pointer' syntax to enable entities within data files or components to be referenced.

This initial set of capabilities is being expanded to encompass a broader range of data that passes between applications during collaborative working in the product lifecycle, including additional product structure information, product manufacturing information and product data management (PDM) metadata.

PLM XML characteristics

PLM XML has three important characteristics that are beneficial to adopters and make it suitable for collaborative interoperability applications.

Open

PLM XML schemas are published at www.plmxml-eds.com. They can be freely downloaded and used as the basis for collaborative applications that are interoperable with EDS' PLM Solutions products or with other PLM XML enabled applications. Developed and maintained by EDS, PLM XML schemas extend to encompass additional product information, including extensions proposed by the adopter community.

Lightweight

PLM XML is by design an efficient, effective and lightweight embodiment of structured product data, geared towards moving essential information between PLM processes. Diverse CAD representations, PLM XML documents, and data streams within structured files and applications can be related to the product structure and referenced using built-in URI and PLM XML pointer mechanisms. Applications that consume PLM XML can therefore selectively access portions of the additional data, depending on need, network capacity, and other scenario constraints.

The ability for any leaf node of the product structure to point to several representations enables the consuming application to choose which ones are appropriate. In this way, for example, the users of a CAD authoring system and of a browser-based visualization system can choose to view respectively the XT file and the facet file representing the same component of an assembly, and collaborate on that basis. This flexibility also makes it possible to view the lightweight representations of components before taking the decision to download the fuller representation if it is available.

Extensible

PLM XML is extensible, so additional data can be transported simply by building on the published schemas. This flexibility allows adopters to describe in extended schemas data that may be highly specialized or commercially sensitive. In this way it becomes possible to transport as much data model as is required without breaking away from the core of PLM XML. Additional or extended schemas can be shared between groups participating in a particular collaborative scenario, and where appropriate considered for inclusion in the published PLM XML schema set.

PLM XML in action pipeline, toolkits and services

PLM XML pipeline

The primary benefit of adopting PLM XML is the ability to share high content product data with a community of adopters and enabled applications, including both EDS PLM Solutions products and other external adopters, via a virtual PLM XML 'pipeline'. The PLM XML pipeline is extending and broadening as more areas of the product life-cycle are reached and more data sources come on-line. This growth is exploited as the PLM enterprise leverages the ability to flexibly share information authored in any area, and PLM application vendors supply programs whose interoperability using PLM XML is built in.

There are several software services mechanisms that together bring the PLM XML specification to life and enable the PLM XML content to be created and exploited, as shown in Figure 4. These include read/write capability provided in toolkit form, adapters to access referenced data, and representation handlers to consume specific representations.

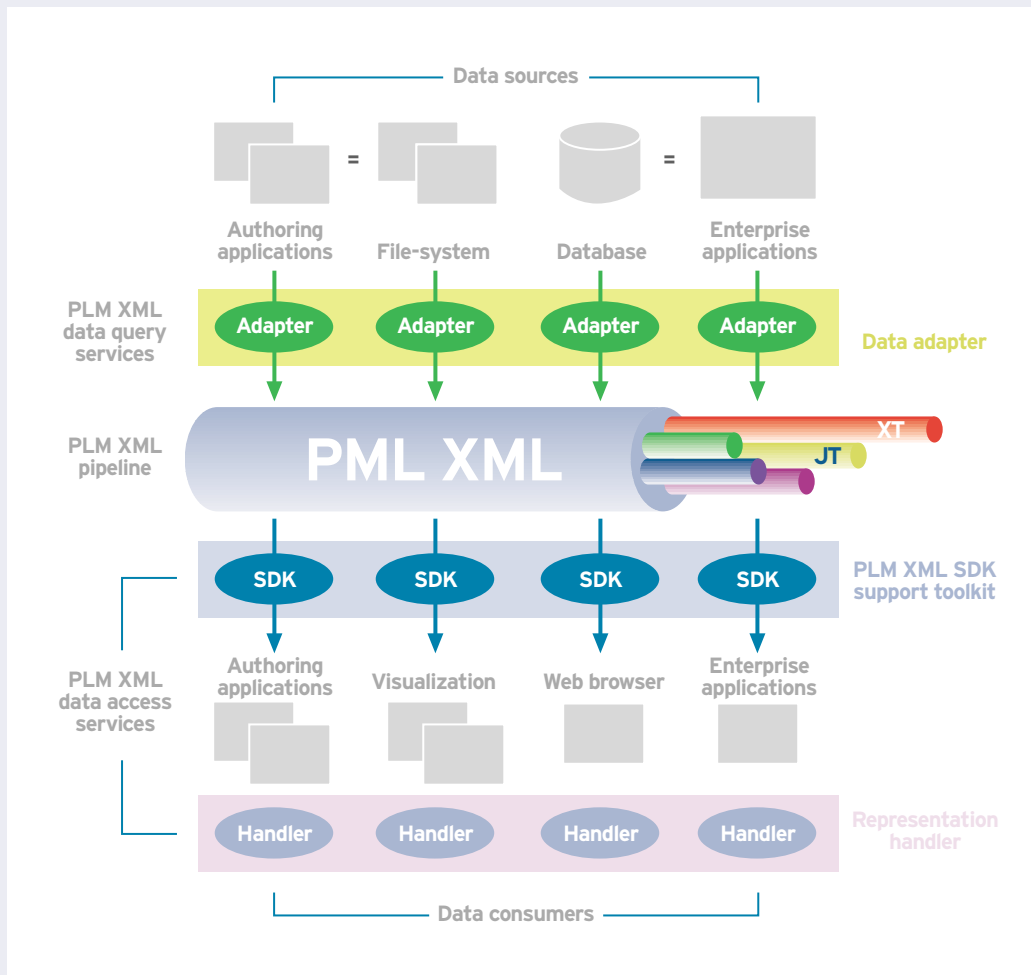


Figure 4. PLM XML services populate and exploit the PLM XML pipeline

PLM XML toolkits

PLM XML support can be built into an application by enabling read, write and interrogation of PLM XML documents and data structures. While this can be done directly from the PLM XML schema definitions and documentation, taking a toolkit approach to implementation can make the integration of PLM XML support modular, and the maintenance and extension of PLM XML support easier.

EDS has created a software developer kit (PLM XML SDK) to enable application developers to build PLM XML support into applications. The SDK is able to author and consume any PLM XML documents that conform to the published schema definitions. It is also object oriented and extensible, enabling an application to build in support for schema extensions, and includes a data adapter interface that provides a framework

for resolving external references. There is also example code and an example Jumpstart application that embodies the above capability (see screenshot below).

The principal benefits of adopting PLM XML SDK as the enabling software are threefold: reduced time to bring PLM XML-enabled applications to market, guaranteed ongoing compatibility with published PLM XML schemas, and rapid extensibility and connectivity via the flexible plug-in framework.

Data adapters

The data adapter is a run-time plug-in that enables an application to access externally referenced representations. It is required when an external reference from PLM XML resolves to a location within a part file or other proprietary location. The main functions of the data adapter are to eliminate the need for authoring applications to be present, and to abstract the particular file format of the representation.

Representation handlers

PLM XML can reference a bulk model representation using either URI or PLM XML pointer syntax, and retrieve it via a data adapter to provide a stream of representation data to the receiving application. To consume this data in native form the receiving application requires a representation handler, a piece of software that can directly interpret the stream of representation data (for example, Parasolid is a representation handler for the XT format). Representation handlers may be implicit in the receiving environment or accessed via web services, and could be full applications, embedded toolkits such as Parasolid, or simple plug-ins.

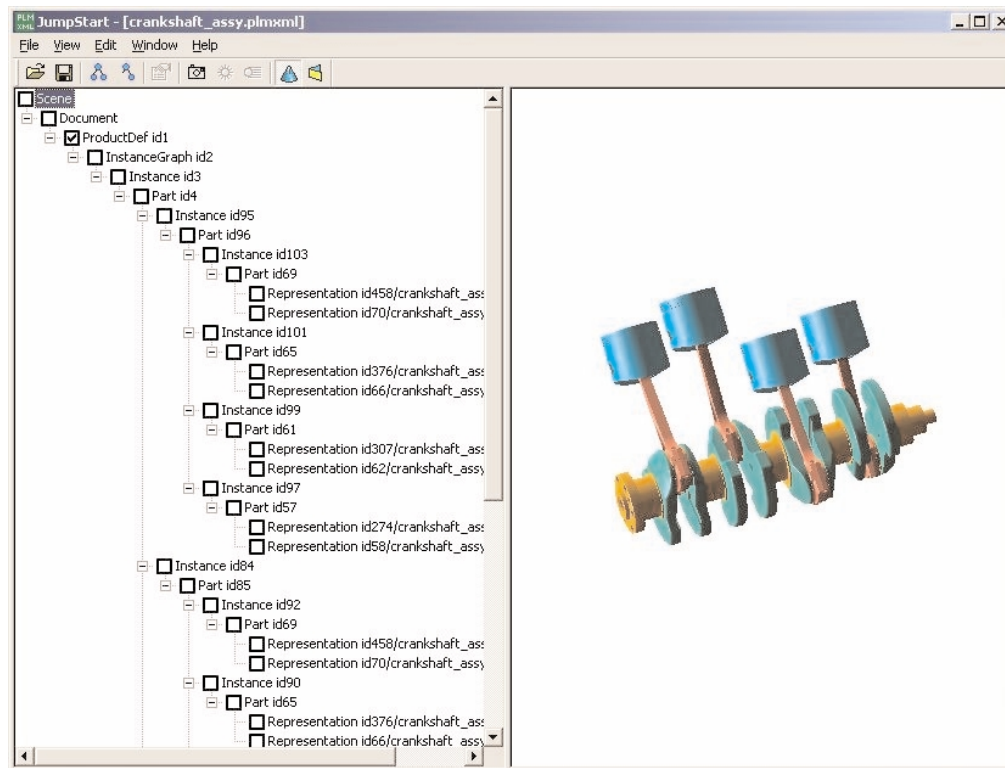


Figure 5. PLM XML Jumpstart application showing a crankshaft example

PLM XML in the enterprise

As a flexible payload definition designed to support PLM interoperability scenarios, PLM XML has many potential applications. The following sections describe generic examples of where PLM XML can be deployed within the distributed enterprise.

PLM XML for interoperability

In certain application interoperability scenarios, for example part file or assembly data exchange, PLM XML can provide a vehicle for sharing product information, allowing common access to structure, attribute data and referenced representations.

Figure 6 shows PLM XML being used both as a directly supported format in sending and receiving applications, and as a tool for abstracting the native part file format to extract the essential product data

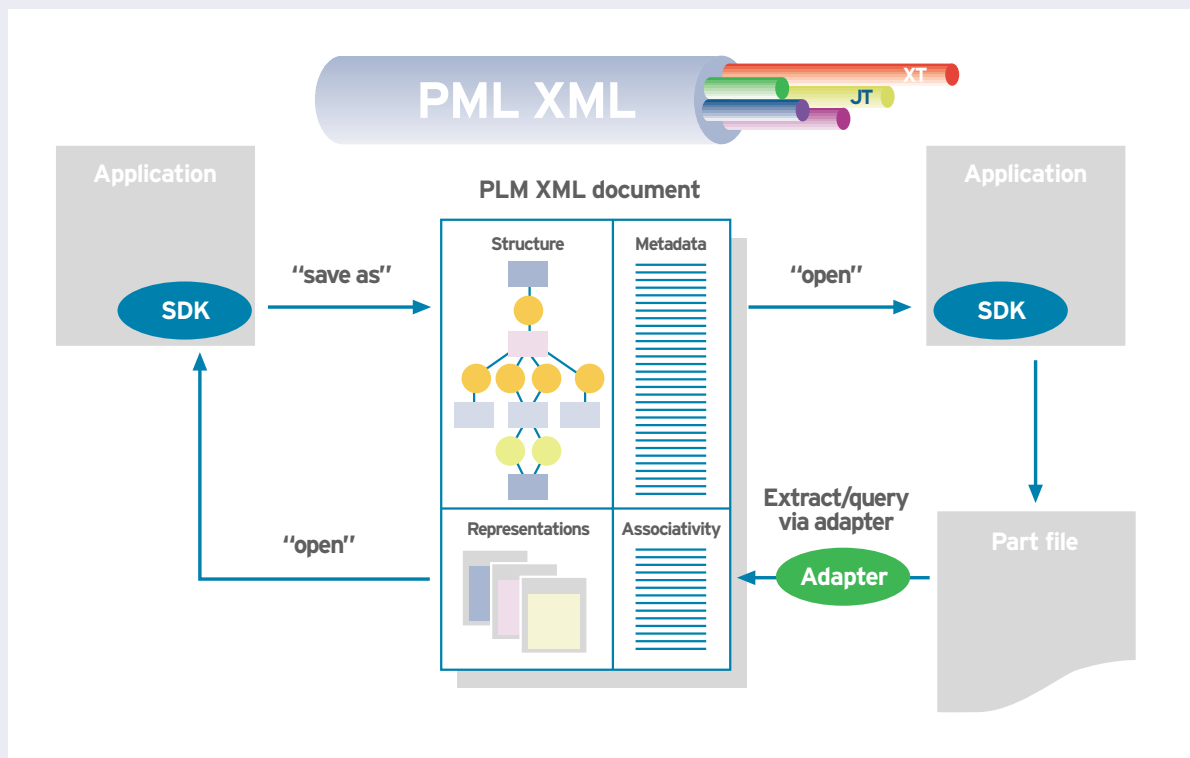


Figure 6 : PLM XML facilitating interoperability between applications

PLM XML for collaboration

PLM XML can be used to deliver a packet of information to an extended team of consumers for collaborative review, and the receiving applications can identify and consume the data most appropriate to their needs and application capabilities.

PLM XML will allow receiving applications to consume selectively the contents of the PLM XML file, enabling the same payload to be used for collaboration with a variety of participants.

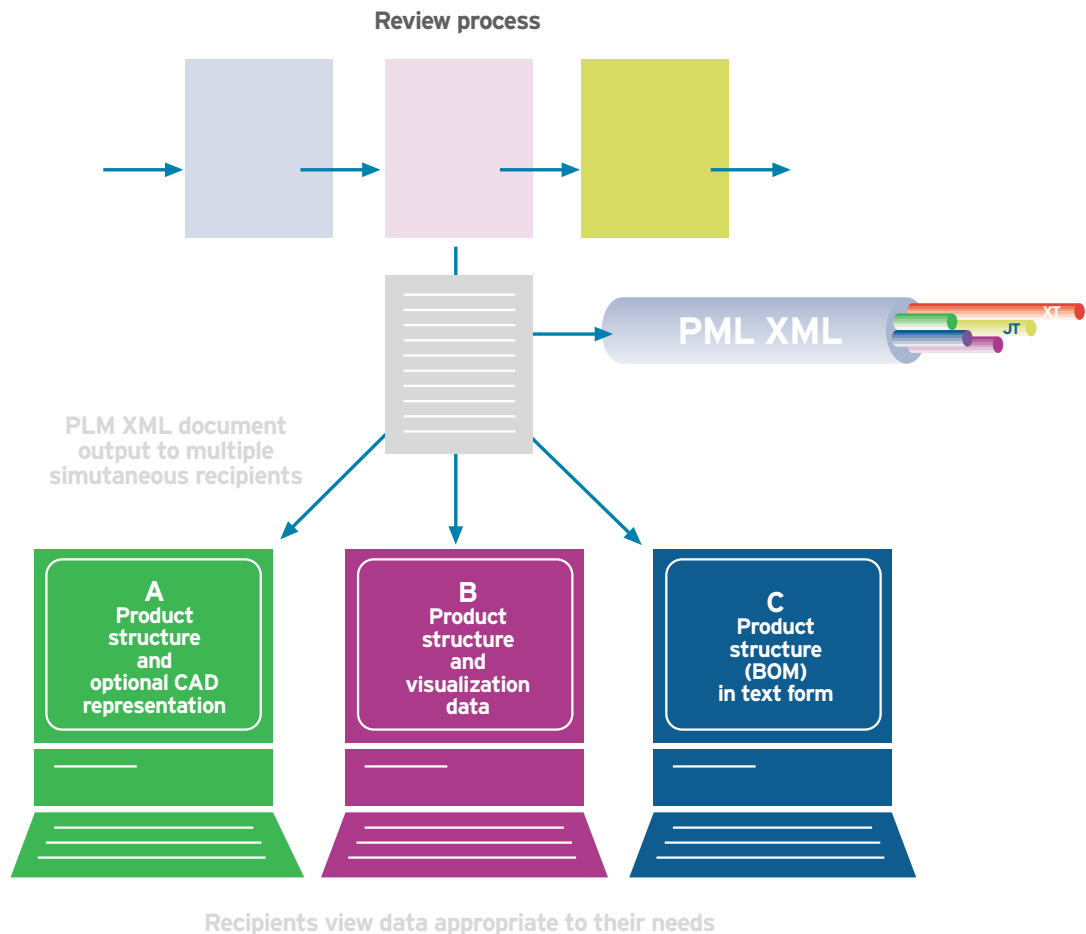


Figure 7 : Flexible PLM XML payload provides appropriate levels of detail

PLM XML for integration

PLM XML can embody the data payload in more formalized enterprise application integration scenarios, where there is a need to compose data payloads from potentially multiple data sources and communicate to multiple recipients within a given transaction context. Using PLM XML means that the payload can be high-level (for example, product structure as opposed to single objects) and can be received and processed in a variety of application environments to maintain consistency across an extended enterprise.

In this way, the PLM XML payload protocol can be used in formalized transactions between tightly integrated systems and at the same time be distributed to more loosely-coupled systems which need to be connected.

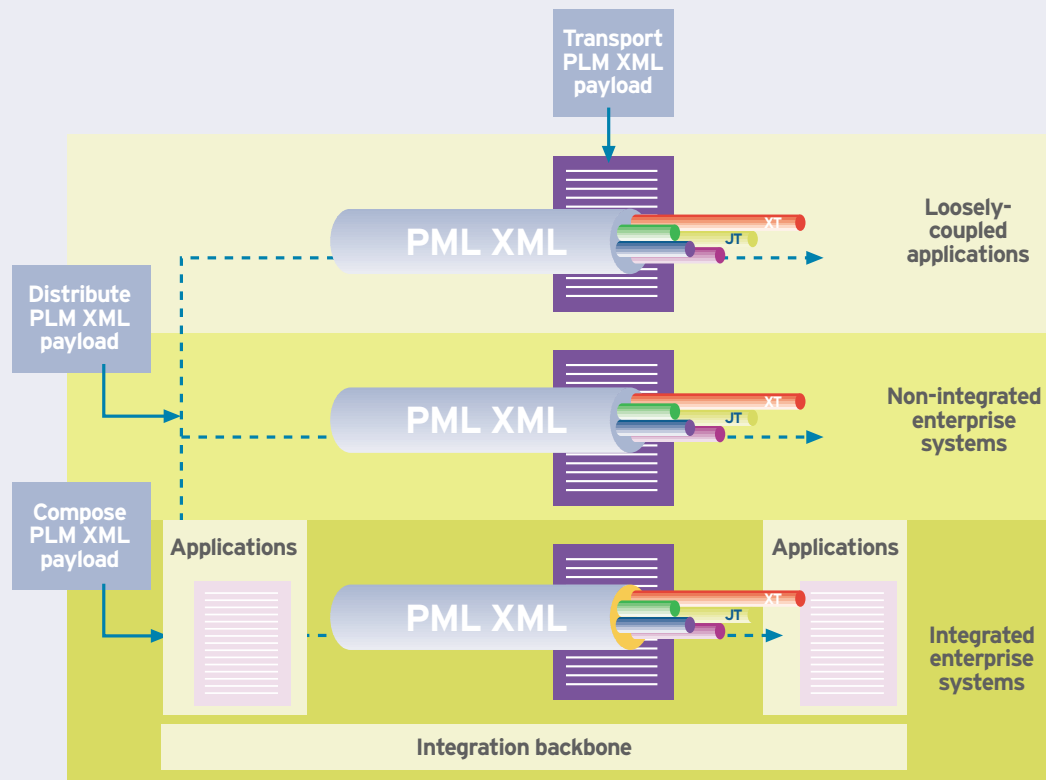


Figure 8 : PLM XML in support of Enterprise Application Integration

PLM XML and standards

XML-based standards for data interoperability and exchange are becoming widespread and of increasing importance in the PLM arena. These initiatives span broad requirements across the supply chain and collaboration domains, and include initiatives that focus either on data content or payload, such as STEP(ml), or on the wider definition of frameworks for collaborative trading and e-business, such as RosettaNet and ebXML. Alongside these standards are efforts such as those of the OAG to define general XML-based exchange protocols, combined with subsidiary developments to furnish content and context for particular vertical industries.

There is, however, no single definition for the complete PLM environment, and applications need to communicate before standards are solidified and fully available. PLM XML is targeted at providing a "working" solution and will leverage appropriate standards in order to complete the definition in given interoperability scenarios. PLM XML complements existing and emerging standards by providing appropriate consistency and compatibility, whilst at the same time providing added value in the particular context of product lifecycle data sharing.

The PLM data model is also constantly evolving, and there is a need to bring applications online quickly. PLM XML allows new application data to be distributed and shared by providing an extensible mechanism that enables connectivity and associativity between disparate data models.

In general the role of PLM XML can be summarised as follows:

- PLM XML is a collaboration/interoperability protocol designed to exchange pertinent PLM information between a range of data sources (PLM systems, data stores & part files) and a diverse set of applications (visualization/mockup, manufacturing, PDM and so on) in support of collaborative PLM scenarios
- The data exchanged is not intended to represent the entire persistent data model of applications found within the PLM process – rather the data exchanged will often be a partial or canonical representation and will include, integrate and reuse other representations where appropriate
- PLM XML enables EDS to respond to continuously evolving PLM processes and data models by quickly integrating new applications and data content into the collaborative PLM process

Summary

PLM XML is an emerging EDS format for facilitating product lifecycle interoperability using XML. It is open, published and based on standard W3C XML schemas. Representing a variety of product data both explicitly and via references, PLM XML provides a lightweight, extensible, and flexible mechanism for transporting high-content product data over the Internet, and aims to form the basis of a rich interoperability pipeline connecting EDS products and third party adopter applications. Complementary to existing and emerging XML-based standards, PLM XML is designed to support scenarios involving application integration, interoperability and data sharing with the aim of improving collaboration efficiency throughout the product lifecycle.

To learn more about PLM XML, visit the website at www.plmxml-eds.com.

About EDS

EDS, the leading global services company, provides strategy, implementation and hosting for clients managing the business and technology complexities of the digital economy. EDS brings together the world's best technologies to address critical client business imperatives. It helps clients eliminate boundaries, collaborate in new ways, establish their customers' trust and continuously seek improvement. EDS, with its management consulting subsidiary, A.T. Kearney, serves the world's leading companies and governments in 60 countries. EDS reported revenues of \$21.5 billion in 2001. The company's stock is traded on the New York Stock Exchange (NYSE: EDS) and the London Stock Exchange. Learn more at eds.com.

About product lifecycle management solutions

EDS is the market leader in product lifecycle management (PLM), providing solutions to the global 1000. Product lifecycle management enables all the people who participate in a manufacturer's product lifecycle to work in concert to develop, deliver, and support best-in-class products. As the only single-source provider of PLM software and services, EDS can transform the product lifecycle process into true competitive advantage, delivering leadership improvements in product innovation, quality, time to market, and end-customer value.

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